

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
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1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE May 8, 1996	3. REPORT TYPE AND DATES COVERED Final: j June 1992 - 31 May 1994		
4. TITLE AND SUBTITLE USE OF GPS-TRACKED DRIFTERS TO STUDY WATER MASS EXCHANGE AND HORIZONTAL DISPERSION NEAR A TIDAL INLET		5. FUNDING NUMBERS : G N00014-92-J-1793		
6. AUTHOR(S) J.H. Churchill and D. G. Aubrey				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Woods Hole Oceanographic Institution		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Department of the Navy Resident Representative 496 Summer St., Room 103 Boston, MA 02210-2109		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES Final report attached.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) This program involved tracking surface drifters, equipped with GPS and VH electronics, in the waters near Beaufort Inlet, NC. The primary objectives were to effect improvements in drifter tracking technology and to study circulation and dynamics near Beaufort Inlet.				
14. SUBJECT TERMS drifters, GPS tracking, nearshore dynamics, inlet studies		15. NUMBER OF PAGES		
		16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT unclassified	20. LIMITATION OF ABSTRACT 3	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

19960703 037

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Final Report
Use of GPS-Tracked Drifters to Study Water Mass
Exchange and Horizontal Dispersion near a Tidal Inlet
ONR Grant No. N00014-92-J-1793

J. H. Churchill and D. G. Aubrey
Woods Hole Oceanographic Institution
Woods Hole, MA 01543
(508)289-2807
jchurchill@whoi.edu

This program involved tracking surface drifters, equipped with GPS and VHF electronics, in the waters near Beaufort Inlet, NC. The primary objectives were to effect improvements in drifter tracking technology and to study circulation and dynamics near Beaufort Inlet.

The drifter tracking operations funded by ONR were carried out in April 1993. In one part of the study, drifter were released at Beaufort Inlet during the early stages of the incoming tide. Drifter were also released at the front separating turbid water exiting the inlet from receiving shelf water. Numerous CTD measurements were acquired in order to characterize the hydrographic properties in the area of the drifters. This work was carried out in conjunction with a NOAA-funded study headed by L. Pietrafesa and D. Logan of North Carolina State University.

Among the technical concerns addressed was the limitation of VHF tracking. With the configuration employed (9-m high VHF antenna aboard the tracking vessel and a 2-watt transmitter with a 1-m whip antenna on the drifter), the tracking range was found to be line-of-sight limited. The maximum range of 16 km was sufficient for attended tracking of a small fleet of drifters. ARGOS positioning was added during times when drifters were left unattended in open water for a day or more. This capacity enabled us to return to within VHF tracking range of the drifters.

Another technical issue considered was the determination of drifter velocity from GPS positions acquired without differential correction. As part of our study of this issue, the statistical characteristics of the GPS position deviations were examined. These were found to have a root-mean-square value of 40 m and a correlation time scale of roughly 3 minutes. Velocity determination from the non-differential positions was accomplished by means of a linear regression technique. This gave highly accurate velocity estimates: typically to within 0.25 cm/s as judged by the 95% confidence intervals of the regressions. Formulae for the uncertainty limits of the computed velocities have been derived. These limits are principally constrained by the correlation time scale of the position deviations.

The technical expertise gained in this study aided the design and conduct of subsequent drifter tracking projects carried out over the northern Hatteras Shelf (as part of a MMS-funded study) and over Georges Bank (as part of the Georges Bank GLOBEC project).

Our study of the circulation near Beaufort Inlet has continued as part of the South Atlantic Bight Recruitment Experiment (SABRE). One aspect of this study has focussed on the fate of water flowing through Beaufort Inlet. The drifter tracks and companion CTD data indicate that surface water entering the inlet tends to flow eastward toward Pamlico Sound (Figure 1), a phenomenon with important implications with regard to incoming larval fish survival. The maximum tidal range of this water was found to be on the order of 12 km. Its tendency for eastward movement is partly attributed to the pressure gradient set up by the fresh water input to the estuarine system, which enters primarily to the west of the inlet. Drifter tracks, combined with current meter data, have revealed strong asymmetries in the tidal flow at Beaufort Inlet. These are accompanied by large (order 30 cm/s) and spatially varying mean flows, directed both into the estuary and seaward.

Results of this study have been presented (by Churchill) at the Mid-Atlantic Bight Physical Oceanography and Meteorology Workshop (Raleigh, November 1993) and at a WHOI seminar (Oct 1993). Some of our findings have been included in a recent masters thesis (Logan, 1995) and NOAA technical report (Logan et al., 1995a). They are detailed in a paper soon to be submitted to for peer review publication (Logan et al., 1995b).

REFERENCES:

Logan, D. G. (1995) Oceanographic processes affecting larval transport in Beaufort Inlet, NC., Masters Thesis, North Carolina State University, Raleigh, NC, 129 pp.

Logan, D. G., L. J. Pietrafesa, T. F. Hopkins, J. M. Morrison and J. H. Churchill (1995a) Physical oceanographic processes affecting larval transport in Beaufort Inlet, NC, NOAA Technical Report (submitted).

Logan, D. G., L. J. Pietrafesa, T. F. Hopkins, J. M. Morrison and J. H. Churchill (1995b) Circulation and dynamics influencing larval transport near Beaufort Inlet, NC., to be submitted to Estuarine, Coastal and Shelf Science.

Early Flood Tide Inlet Releases: April 1993, 1994 & 1995

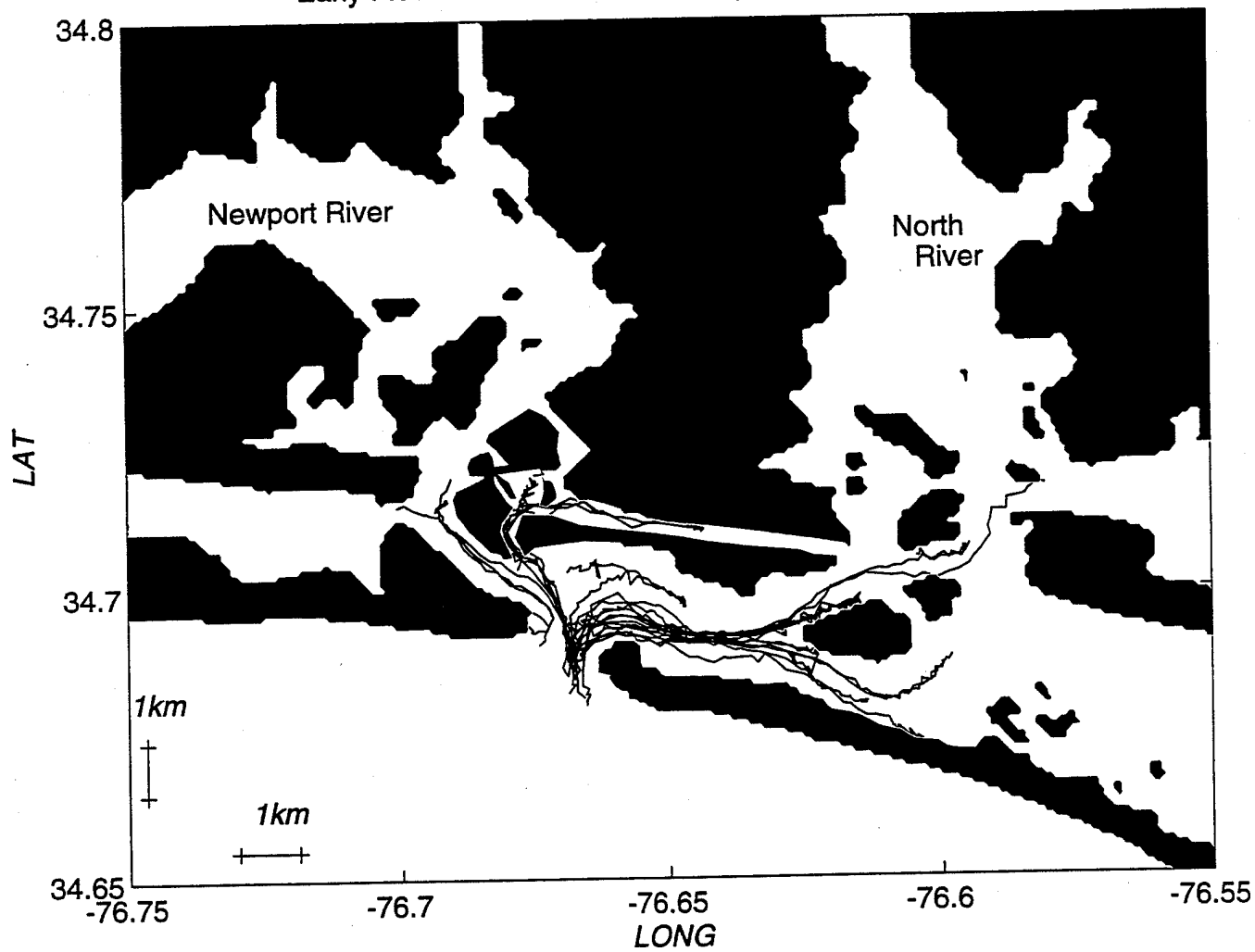


Figure 1. Tracks of drifters released at Beaufort Inlet early in the flood tide.